

present is gaining weight and health and has had no return of symptoms.

Looking back over the histories of the cases presented here this evening, let us see what has been gained and what has not.

One patient died without any relief three days after the gastroenterostomy, which was performed one month after another operation, with the patient in a condition of extreme exhaustion. The operation was undertaken purely with the hope of being able to do something, as it was recognized that death would take place in a very few days. There is a question that if the gastroenterostomy had been performed at first in the face of the complete relaxation of the pylorus, whether the symptoms would have been cleared up.

The patient on whom a pylorotomy and subsequent gastroenterostomy was done, died eleven days after operation from exhaustion caused by inability to swallow, and also to retain any rectal nourishment. No autopsy was obtained and can offer no solution of the trouble. For the time being he was entirely relieved of the symptoms for which the operation was undertaken.

The patient operated upon by Dr. Huntington had an extensive carcinoma of the pylorus and had one year with entire relief. Death then occurred from an old endocarditis. At autopsy no metastasis of the carcinoma was found, and also that the growth had not extended during the year. A strand of celluloid linen which had been used for the inner line of sutures was found hanging to the anastomosis.

One patient who had a bad heart lesion and who collapsed twice on the table, obtained entire relief, left the hospital against our advice and worked one day. He returned two days later with a dilatation of the heart and lost compensation, and died eight days afterwards.

All the cases except one obtained complete relief from pain, which was the symptom which led them to seek help and readily consent to operation.

Most of these cases have been diagnosed and operated upon solely by subjective symptoms, and although we have not demonstrated an indurated ulcer in each case when ulcer was suspected, the entire clearing up of the symptoms subsequent to gastroenterostomy gives sufficient evidence that our operative diagnosis of a mucous ulcer was correct.

In two of the patients their true condition was overlooked for three years and another patient for one year. If this has occurred in our limited experience there must be a great many more patients with ulcer of the stomach or duodenum with the ultimate probability of cancer, who are being treated for neuralgia of the stomach or heart, or indigestion, when if proper attention were paid to the characteristic symptoms they would be sent to a surgeon who would give them the benefit of this ingenious and comparatively safe operation.

Gastroenterostomy will not cure neurasthenia, but if it is dependent upon any of the conditions above enumerated, relief will be given.

Gastroenterostomy is essentially a drainage oper-

ation and if undertaken for the relief of symptoms which are induced by faulty drainage, you will make a most grateful patient, an admirer of the medical profession and not allow him to become a victim for quackery and a candidate for Christian Science.

## OBSERVATIONS ON SPINAL ANALGESIA.\*

By ALFRED NEWMAN, M. D., San Francisco.

Almost a decade has elapsed since the introduction of spinal analgesia to a waiting medical world, ever eager for the recognition of any discovery looking to greater comfort in operative surgery. Since the time when this form of anesthesia was first practised, much vicissitude has attended it, as indeed has been the common lot of almost every notable discovery in medicine.

To America must be accorded the credit of the first discovery of this principle, which however was allowed to lie dormant until re-discovered by a German. It was eagerly adopted by the French, and by them introduced to the entire medical world. Although not the discoverers, the French are really the promoters of spinal analgesia.

First reports regarding the new method were all favorable,—prematurely so; indeed, by many it was claimed that the ideal anesthetic had at last arrived. Then came the inevitable reaction. Accidents of a disagreeable character began to be reported, accompanied by a death-rate which compared unfavorably with that of chloroform or ether.

Threatened with oblivion, under these circumstances, modifications of the original method were suggested; the cocaine was dissolved in the spinal fluid, adrenalin was added; other drugs were substituted. Of the substitutes whose action next came under observation, two have sustained and survived extended test, and are in vogue at the present time: stovaine and tropa-cocaine. The former is a French synthetic and owes its great popularity largely to the patriotism of the French. It is named after its discoverer, Fourné—French for "stove." But the use of this drug is on the decline. I have long since abandoned it in favor of tropacocaine, whose use has given much better satisfaction.

Concerning the latest substitute for Cocaine, Novocaine and Aylpin, I have no personal experience, but up to the present time at least, reports of operators show them to be much inferior to tropacocaine. With the development of spinal anesthesia, we have passed through the cocaine, the stovaine and the tropacocaine eras, finally settling upon the last as the best drug thus far discovered. Others have arrived at the same conclusion and are abandoning all other drugs for the tropacocaine. The reason for this late recognition—Schwartz has used it since 1901 and has always praised it ("Munch Med. Woch." 1902. No. 4)—lay in the initial poor results it gave. This was largely due to the quality of the drug. Bier, after abandoning it, has returned to it. Our first

\*Read before the San Francisco County Medical Society.

results with it were very disappointing, and all my failures occurred at that time.

The quality of the drug, then, is a very important factor. This has more significance with regard to tropacocaine than with cocaine or stovaine; for while there is only one preparation of the last two, both tolerably reliable, of the first there are two, a natural and a synthetic. The natural, derived from the coca tree, rich in the alkaloid, has given us and others uniformly good results; the second, uniformly poor results. As we preserve the drug dry in hermetically sealed vials, we have nothing to fear from deterioration or decomposition. This does not apply to the drug in solution, especially with the addition of adrenalin, as used abroad. Adrenalin in solution decomposes very readily, so that many disagreeable after-effects have been attributed to the use of old solutions. For example: Hermes (Sonnenberg's clinic) had 17 after effects in 117 stovainizations, without adrenalin and 17 in 95 with. Baesch, using Alypin alone, had 2 after effects in 10 cases; with adrenalin 10 in 27. Therefore, it is advisable to avoid all ready-made solutions and make your own anew for each operation, a very simple matter with the sterilized salt.

Cocaine and tropacocaine form clear solutions with the spinal fluid, but stovaine, owing to its great susceptibility to alkalies, at once becomes milky, forming an emulsion. This reaction of decomposition, however, does not interfere with its anesthetic properties.

**Dosage**—Cocaine I can dismiss with few words, as that has been practically abandoned. I only wish to say that in the early days I used some very large doses. It was no unusual thing to use over half a grain, and at one sitting a patient received three injections, about  $1\frac{1}{4}$  grains in all, and never had a single after or accompanying effect. Later the dose never exceeded one-half grain (Compare Legueu, two deaths after  $\frac{3}{10}$  grain and  $\frac{1}{4}$  grain respectively. *La Presse Med.* 1901. 90 Deux cas de mort immediate par rachicocain). Viollet used as much as C:08 ( $1\frac{1}{3}$  grains). Morton up to  $\frac{1}{2}$  grain).

The dose of stovaine is from 4 to 6 centigrammes ( $\frac{2}{3}$  to 1 grain) although much larger doses have been given with impunity. (Becker as much as 0.104—over  $1\frac{1}{2}$  grains). But as we never can tell who will be the susceptible patient, it is well to stay within the safety limit. As little as  $\frac{1}{6}$  grain has been reported to have caused death (Pouliqueu by Billon and Geraude).

The dose of tropacocaine is 0.05 to 0.06 ( $\frac{5}{6}$  to 1 grain), although there are many exceptions to this also. I have used up to  $1\frac{1}{4}$  grains, but this dose will cause considerable fall in blood pressure in old people. Franchesci, Vienna, on the other hand, uses as much as  $1\frac{1}{2}$  gr. (1.10) in children under 15, while adults receive as high as 15 centigrams ( $2\frac{1}{3}$  grains). This looks like an enormous dose, but as he sterilizes at a very high temperature ( $130^{\circ}$ ), he probably reduces its activity. Schwartz, one of the earliest and most enthusiastic advocates of tropacocaine, never exceeds 0.06 (1 grain). Bier, since

his fatality with 0.13 (2 grains) places the maximum dose at 0.05 ( $\frac{5}{6}$  grain). This was his first fatality in over 1000 cases, and was entirely due to the overdose. That a smaller dose can cause death is shown by Urban's case. ("Wiener Med. Woch": 1906. 51 & 52) where a 31-year-old man with double hernia received 1 gr. dissolved in 4 c.c. of liquor between the 3rd and 4th lumbar spines, and died two days later in delirium and great dyspnoea. It would seem difficult to reconcile Franchesci's huge doses with no mortality, and Urban's small doses with large mortality, for, besides the above, he had two more fatalities (one stovaine and one tropacocaine).

**Sterilization**—This is accomplished with dry heat. The drug having been weighed out and put in previously sterilized and thoroughly dried vials, is placed in the autoclave for 20 minutes, and subjected to a temperature of  $110^{\circ}$  to  $115^{\circ}$  Cent. The corks are then inserted and the bottles heated another 20 minutes at  $100^{\circ}$  to  $105^{\circ}$ . They are then allowed to cool and the corks are marked and sealed with paraffin. These bottles will keep for years. You can also sterilize the drug in papers, in the same manner, but of course with some sacrifice of keeping power. This amount of sterilization is amply sufficient, for tropacocaine is in itself antiseptic. A grain of it in a bouillon tube will inhibit the growth of the resistant staphylococcus pyogenes. Koslowsky uses it just as it comes from the manufacturer without any sterilization at all. (Centralbl: f. Chir: No. 45. 1902.) Franchesci, on the other hand, goes to the opposite extreme as above noted.

If there is any one element in which spinal analgesia has been rich it is technic. One could almost say as many operators, so many varieties, and it will not be until there is one accepted method that we shall get any statistics that are really valuable. As in all other procedures, so, here, the simpler the better. A method such as used by Kronig can never become popular because of its cumbersomeness. He consumes three minutes in giving the injection, so as to produce no disturbance in pressure read off on a manometer about  $1\frac{1}{2}$  feet long attached to the needle and held up by a special assistant. Dark glasses to shut out visual and a pair of ear flaps to shut out auditory impressions, complete the performance. Some operators carefully avoid spilling any of the spinal fluid. Others allow it to run away freely. Some use the obturator in their needles, others do not, and so on indefinitely. My technic is now as follows:

**Technic**—The instruments consist of two spinal needles, diameter 1 m. m., length  $7\frac{1}{2}$  c. m. (about three inches), a Luer syringe holding 2 to 5 c.c. and a glass of sterile water. First clear your needles by injecting a syringeful of the water, for, if you notice, the first drops will be dirty owing to rust and particles from the inside of the needle. At the same time note that the syringe fits. Do not wait till you have your needle in the patient's spine before making the discovery. Then place the patient upright, with legs hanging over the side of

the table, have his back prepared as in a laparotomy. Others are not so particular. (Veit Stuttgart Beitr: zu Kl. Chir., Vol. 53, No. 20), simply rubbing with cotton and ether. When all is in readiness, locate the third lumbar spine; a line joining the highest points of the iliac crests will run between the third and fourth lumbar spines, with the patient bending well over. You then choose the interspace you wish to enter, bearing in mind that the cord as a rule extends down to the lower border of the body of the first lumbar vertebra. Placing the left thumb on the tip of the spinous process, define the interspace and grasping the needle in the hand like a trocar, pass it directly above the thumbnail into the back in the median line. In case of a very prominent interspinous ligament, it may be necessary to pass the needle from the side, but whenever possible, use the median route. When the needle pierces the dura, it imparts a peculiar crashing sensation to the hand; at the same time, the patient feels a sharp pain. Being in the subarachnoid space, the fluid should at once appear. If it does not, have the patient cough, as this often starts the flow by displacing some nerve that may be blocking the entrance to the needle. If this fails, pass the stylet; a shred of tissue may be caught in the lumen. If this does not avail, look to see if you have remained in the median line. The needle point may have been deflected. In that case, draw the needle out to the skin, not through the skin, change its direction, and re-insert. If then you fail, try another interspace. Should the fluid be bloody, wait until it runs clear before injecting, although I have injected bloody fluid without any untoward effects. Having obtained a free flow of fluid, let it run into the bottle containing the tropa-cocaine. Then allow varying amounts to run off, 3, 4, 6, 8. c.c., depending on the intraspinal pressure. Take the second needle, stir the drug till dissolved, draw up into syringe, insert latter into spinal needle, being careful not to spill any, an accident that very often happens to beginners, and first allowing the spinal fluid to flow back into the syringe, inject, forcibly for a higher, gently for a lower anesthesia.

Withdraw the syringe and needle, keeping the finger on the plunger to prevent regurgitation. Seal the puncture with collodion, and prepare for operation. Where the patient cannot sit up, you must puncture him lying, while, if he cannot bend his back, the puncture may become a very difficult matter. Naturally, in case of ankylosis of the spine with an ossified ligamentum subflavum, it will be impossible to reach the medullary space.

Regarding the withdrawal of spinal fluid, I had observed that when the analgesia failed, or was inadequate, the spinal fluid had been under considerable pressure.\* This increased pressure apparently

prevented the isotonic solution from ascending. Acting upon this idea, I withdrew various small amounts of fluid to lower pressure and increase the height of the analgesia. The few cases (five) in which I have had an opportunity of trying this, all acted splendidly, both as to anesthesia and after-effects. As is usually the case when we think we have found something original, this had been done before by Chaput and Offergeld to avoid the disagreeable after-effects; by Filliatre, both for this reason and to increase the extent of the analgesia. In the Bier clinic, they also allow the fluid to run off, and yet Bier, in his earlier publications, warned against this very practice. This goes to illustrate the constant change taking place in the technic of spinal anesthesia, in the endeavor to perfect the same. I have seen only good results from this procedure, while Filliatre, who still uses cocaine, claims to have robbed the latter of all its terrors thereby.

*Indications*—We have confined our operations to the region below the umbilicus, having performed a ribresection and ovariectomy and appendectomy only once (cocaine). The reason for this was the uncertainty of the anesthesia above the umbilicus and very often below the umbilicus. According to Tuffier, the method works best in operation of the bladder, hernias and lower extremities. Chaput summarizes his conclusions in 309 cases of stovaine analgesia, as follows: The method is wonderful for the lower extremities, the perineum, genitals, hernias, colostomy and appendicitis. Contra-indicated are young children, very nervous and very cachectic patients.

The prevailing opinion at present tends to conservatism, rather to contract the sphere of spinal analgesia and to confine it below the umbilicus. This is in marked contrast to the enthusiasm with which the method was practised in the early days, when Tuffier (1900) proclaimed it the great rival of general narcosis for all operations below the diaphragm.

There are certain conditions in which spinal analgesia is specially adapted—diabetes, old age, heart disease and lung disease.

By placing this limit to our sphere of operation, we get fewer failures and far greater satisfaction from the method. This and the perfection of technic will tend to render spinal analgesia reliable and rid it of the continual reproach of uncertainty, so that anyone, after little practise, will be able to get the results that now only experts get.

With one exception all operators report some failures in their series:

Chaput (1901)—Cocaine; 57 cases; 11 misses.  
Lea (1902)—Cocaine; 18 cases; 5 misses.

Preindelsberger (1905)—Tropa; 260 cases; 20 misses (14 times superficial).

Hermes (1905)—Stovaine; 90 cases; 4 misses (twice on same patient).

Barker (1907)—Stovaine; 100 cases; 11 misses in first fifty.

Kurzvelly (1905)—Cocaine-Adrenalin; 53 cases; 5 misses.

\* Oelsner, in reporting the experience with sp. anest. from Sonnerburg's Clinic, says that the best results were obtained in those cases in which the sp. fluid dropped from the needle, while all the failures were registered in the cases where the fluid spurted forth. They therefore allow considerable fluid to run away in such cases. Anesthetic is stovaine—Billonborate of epinephrin, 0.00013, stovaine, 0.04, NaCl, 0.0011 to the cc. This makes a solution that is about isotonic with the sp. fluid.

Bosse (1906)—Stovaine Alypin Novocaine; 55 cases; 8 misses (6 complete).

De Franchesci (1906)—Tropa-Cocaine; 420 cases; 1 miss.

Sonnenberg (1906)—Novocaine-Suprarenin; 354 cases; 17 misses.

Sonnenberg (1906)—Novocaine-Suprarenin; 82 cases; no misses.

Steinthal (1906)—Novocaine; 69 cases; 9 misses.

Steiner (1906)—Stovaine; 50 cases; 10 misses.

Babcock (1906)—Stovaine always achieved a certain degree of anesthesia; it often sufficed.

Donitz (1906)—300 cases; 4 per cent misses.

Morton (1902)—Cocaine; 673 cases; no misses (60 above the diaphragm.)

In 102 cocaine analgesias, I had four complete failures that is, absolutely no anesthesia; in the first series of tropa-cocainizations, 35 cases, dose, 2-3 to 1 grain, there were two failures; with stovaine, 11 cases, no failures; in my last 52 cases with tropa-cocaine, dose, 1 to 1¼ grains, natural product, there were no failures. Of incomplete anesthetics, that is, where the analgesia did not extend high enough, cocaine gave 11, tropa-cocaine, first series, 4; stovaine 1, and tropa-cocaine, second series, 3 cases. Of these 3, 2 were due to gross errors in technic. In one the syringe leaked, in the other on injecting forcibly, the syringe slipped from the butt of the needle, and most of its contents were spilled. In the third case, operation for inguinal glands in very nervous patient, the analgesia with gr. 1 reached to the thighs only. Nervous patients generally make poor subjects for anesthesia, whether general or spinal. Guinard has lately reported two cases of fatal syncope produced by fear, before the anesthesia was begun. In these nervous patients, increased pressure of the spinal fluid seems to be the cause of the faulty anesthetics.

*Height of Anesthesia*—It has been the constant reproach of spinal anesthesia that it is undependable and inconstant. It is not there when you want it, and everywhere when you do not want it. Provided that the correct technic is used, and provided that too much is not demanded of the method, I believe that in the future we shall be able to overcome that reproach. Aside from the drug and the technic, the two explanations of the uncertainty of this procedure are injecting too far forward in the spinal canal, thereby entangling the solution in the meshes of the corda equina and thus hindering its ascension (Donitz), and the increased pressure of the spinal fluid. First reason is particularly applicable to those who use a needle with obturator in making the puncture. But it can also happen when the plain needle is used. I have already inserted the needle to the anterior wall of the spinal canal before getting the liquor to flow. Regarding increased pressure, we have frequently noted that where the spinal fluid spurts forth, with our needle it normally drops, the anesthesia is likely to be low. As an example of this, the following case is very instructive: The patient was one who had already been injected three times. At the fourth injection I tried the experiment of cording the lower limbs,

expecting thereby to reduce intracranial pressure and get high anesthesia, but, instead, I got the direct opposite. As this one case illustrates a number of points, I shall briefly report it.

Patient—Sam B., age 34; internal organs normal; operation, wiring of fractured femur, September 4, 1906. Tropa, gr. 1, between second and third spines. Patient sitting; small syringe; fluid dropped clear. Anesthesia to umbilicus. Course, ideal. Post op., no headache, no retention of urine, no nausea, no vomiting.

Second puncture, October 23, 1906. Removal of wire, puncture between second and third spines; tropa, gr. 1, between the second and third spines; small syringe; patient lying on left side. Fluid dropped as before. Anesthesia to the anterior sup. spine. Anesthesia began on the left side first. Course during and post op., ideal.

Third puncture, November 8, 1906. Tropa, gr. 1, between the third and fourth spines; small syringe; patient on right side. Spinal fluid as before. Anesthesia, prompt and equal on both sides up the ant. sup. spine. Post op., as previously.

Fourth puncture, January 12, 1907, breaking up adhesions in the kneejoint; ten minutes before the puncture, legs corded with rubber bandage. Tropa, gr. 1, between second and third spines; patient sitting up; spinal fluid spurted out, that is, under pressure; anesthesia only to anterior, sup. spine. Post op., no vomit, no retention, but severe headache for seven days.

This case, then, serves to demonstrate four facts: (1), That you get a higher anesthesia by puncturing in the sitting than in the reclining position; (2), that the side on which the patient lies sometimes becomes anesthetized first; (3), that increased intraspinal pressure lowers the level of the anesthesia (this I have noted often in other patients repeatedly anesthetized); (4), that under the same condition the action of the drug is the same. The severe and prolonged headache following the last operation was probably due to increased pressure. Height of anesthesia, then, will depend upon proper technic, pressure of the spinal fluid, and posture. To this I may add level at which the puncture is made, and size of dose. Still, even with a large dose, high pressure will depress the anesthesia. To illustrate:

G. Rossi, age 29; scrotal hernia. Tropa coc., grs. 1¼, between second and third spines. Patient very nervous. On prick of needle straightened up, so that I had to puncture a concave instead of a convex back. Spinal fluid spurted out in a wide stream, great pressure. Injection given forcibly with a 5 c. c. syringe. In 20 minutes the analgesia was only at the anterior superior spine, and in 40 minutes had disappeared from the entire body.

Therefore, to secure high anesthesia, inject high up, say between the first and second lumbar spine, and lower or overcome the pressure of the spinal fluid. There have been various methods suggested of accomplishing this latter; one is to use large quantities of the spinal fluid, 5 to 10 cc. as a solvent (Eden); second, the use of the Trendelenburg position (Kader); rapid and forcible injection (Morton); injection in the cervical region (Tait and Cagliari), allowing various amounts of spinal fluid to run off, then injecting the tropa coc., dissolved in 5 to 10 cc. I have tried this latter as yet in 5 cases only, allowing between 3 and 6 cc. to escape. The doses were 1 grain and 1¼

grains (2 cases) given between the second and third spines. Analgesia reached to the nipple and no headaches followed. This method has been given a most thorough trial by Lefilliatre. His article appeared in the *Journal de Medecine de Paris*, 1905, Nos. 29-31, under the title, "*Nouvelle Technique permettant une immunité absolue.*" He allows 6-10-30 cc. to run off from the time the liquor begins to drop. He claims that this procedure renders spinal analgesia so harmless that he still retains the use of cocaine. Here, then, we have one of the incidents that makes the study of spinal analgesia so bewildering. Author after author, from the time of Quincke down, has emphasized the necessity of losing as little spinal fluid as possible, and here is a man who loses as much as possible, with the best of results. When we consider, however, that in operations on the spinal cord we lose not *minims* but *ounces* of fluid, this procedure does not appear so revolutionary. Furthermore, those patients whose spines have been operated upon have not presented any of the symptoms that often accompany spinal cocainization with loss of little fluid.

My highest anesthesia in the last 52 tropa-cocainizations was one up to the neck (brachial plexus), in a man of 56 operated for hernia; dose, gr. 1, between the first and second spine. In the days of cocaine, I sometimes got anesthesia of the entire body, but my records having been destroyed, I cannot state the number of times. However, latterly, we have never tried to do high operations with tropa-cocaine, for, firstly, it was not under control; and, secondly, the anesthesia was too short.

One of the chief faults of tropa-cocaine has been its brief duration. While  $\frac{1}{2}$ -grain dose of cocaine gave a 2-hour anesthesia at the anterior superior spine, a  $1\frac{1}{4}$ -grain dose of tropa-cocaine gives scarcely an hour. In  $1\frac{1}{4}$  hours, the anesthesia will recede from the margin of the ribs to the middle of the thighs. It will remain at the anterior superior spine for 20 minutes, and then begin to descend. Stovaine gives a longer anesthesia. With a  $\frac{1}{2}$  grain of cocaine, or a little more, it was sometimes  $3\frac{1}{2}$  hours before the anesthesia left the anal region, while  $1\frac{1}{2}$  grs. of tropa-cocaine will at times give only a 40-minute anal anesthesia. As a consequence of this, do not use the latter in prolonged operations, and in cases where you do use it, operate quickly.

Now, touching the matter of the use of adrenalin in spinal analgesia, I have tried it in a few cocainizations, and found it absolutely valueless in sustaining blood pressure, or avoiding the disagreeable accompaniments. It may be that boiling rendered it inert, although assured to the contrary by the manufacturers. Sikemeier (*Centralbl. f. Inn. Med.*, 26, 1906; p. 669 ref.), as a result of 52 animal experiments and clinical experience, found that the addition of adrenalin had little or no influence in increasing the anesthetic power of cocaine. He found at the same time that it did not lessen its toxicity. On the other hand, it is quite possible that adrenalin may have a large share in the responsibility for the paraplegias and eye muscle

paralyses that have occurred since its introduction into spinal analgesia. Biberfeld (*Deut. Med. Woch.*, 14, 1907), in animal experiments, noticed that its first effect was absence of pupillary reflex, a sign that the suprarenin had paralyzed the ocular motor centers. Furthermore, he frequently got paralysis of legs in cats and rabbits as consequence of the spinal anemia. He therefore asks whether adrenalin may not have something to do with the paralyses and sudden deaths after spinal analgesia. One thing is certain, it is a powerful irritant, and is therefore capable of inflicting damage to the spinal cord. For this reason, many operators have never used it, and those that have are gradually giving it up.

Nothing better illustrates the difference in the toxicity of cocaine and tropa-cocaine than a comparison of their actions on the operating table. There is only one expression with which to characterize the course of a tropa-cocainization, and that is ideal. Compared with cocaine, it is benignancy itself. Twenty minutes after a spinal cocainization with almost clock-like regularity, the patient became pale, nauseated, vomited. The pulse got weak, and the blood pressure rapidly fell. Involuntary defecation occurred, and the patient, with sighing respiration, lay on the table in a drenching perspiration. In one instance, hernia in an elderly patient, no radial pulse could be felt at all for half an hour. Needless to say, such incidents tended to make the operator very uncomfortable, to say nothing of the patient, and cocaine very unpopular. Even worse, was the experience that at times, with only slight or no anesthesia, you still got violent intoxication symptoms. Lefilliatre, after an unsuccessful injection of 1-6 gr. cocaine, got a paraplegia. With tropa-cocaine, on the other hand, such symptoms are of the greatest rarity. In 89 cases, there was only one of incontinence of faeces in a very anaemic, weak, tubercular woman, who was suffering from incontinence before the operation. Shock such as followed cocaine never occurred. Patient scarcely ever even perspired. In one man of 56, the pulse went down to 44, but 1-100 gr. of atropine promptly brought it back to 70. In this case,  $1\frac{1}{4}$  grain was given between the second and third lumbar spines; spinal fluid clear; low pressure. Small syringe, injection gently made; anesthesia to the ensiform cartilage. No nausea or perspiration; operation for ununited fracture of neck of femur. This same patient had had a previous injection of gr. 1 between the first and second lumbar spines, given forcibly with analgesia onto the neck, but without any untoward symptoms. Tropa-cocaine does have a slight depressant effect on the vaso-motor system, but by far less than that of cocaine. With stovaine, my personal experience is slight; only 11 cases; but amongst these there was one of slight shock, 40 minutes after administration. On the table, therefore, stovaine, in doses of 4 to 6 cgms., gave practically no untoward symptoms in my series. If it had acted as well after operation, it would have been the ideal anesthetic. When I abandoned

stovaine, I had not yet heard of its paralytic effect on the eye muscles (adrenalin?) on the respiratory centers, of the paraplegias, nor of the deaths following it; but the fact that the alkaline spinal fluid decomposed it, that it was a motor as well as a sensory paralyzer, and that the patients, almost without exception, felt so absolutely miserable afterward, with headache and vomiting; prejudiced me unalterably against it.\*

The question whether these intoxication symptoms are due to the action of the poisons on the higher centers directly, or indirectly through the circulation, has given rise to much discussion and experiment. I consider them due to action by way of the circulation, because, (1), In cocaine analgesia they always occurred about the same time after injection, regardless of the extent of the anesthesia; (2), they often occurred when there was little or no anesthetic action of the drug; (3), in universal analgesia (cocaine), where one would expect them most frequently, you got them least frequently. Clapp, from Bier's clinic, found that substances are absorbed into the general circulation more quickly from the sub-arachnoid space than when injected sub-cutaneously, and referred the tolerance of old people for cocaine to their slow circulation. (*Archiv. f. Clin. Chir.*, No. 75.) Heinecke & Laven (*Archiv. f. Clin. Chir.*, 81), by experiments on rabbits and cats with novocaine, concluded that absorption into the circulation was not a factor, but that the untoward results were due to the direct action of the drug upon the spinal cord. The only comment I have to make is that while these experiments may be perfectly correct in so far as they effect the lower animals, we should exercise some reserve in their application to human beings. For instance, a  $7\frac{1}{2}$ -gr. dose of morphine, while a safe anesthetic dose for a dog, would be rather dangerous if applied to a human being.

The after-effects of a spinal analgesia begin to show themselves as soon as the analgesia wears off. They comprise pain in the wound, pain in the back, nausea, vomiting, headache, retention of urine. Further and more infrequently occur paresis of lower extremities, of which we had one case; monoplegia, paraplegia, paralysis of eye muscles, none of which has fallen to our lot.

Headaches occur quite frequently and with varying intensity, at times reaching the atrociousness of the pain in meningitis, as after stovaine analgesia, again amounting merely to a slight discomfort (tropa-cocaine). These headaches may last a long time, for weeks and months in fact. The longest in my series was 7 days after tropa-cocaine. One case reported by Deetz had lasted 6 weeks at the time of publication. One from the Charite in Berlin lasted 5 weeks. While headaches of from 5 to 14 days' duration are frequent, these have all followed stovaine.

\* Schwarz (Oelsner) reports examination of urine of 60 patients after sp. stovaine-adrenalin—13 were normal, 47 showed evidence of nephritis, 28 rather severe ( $\frac{1}{2}$  per cent albumen and many cylinders), 4 very severe (2 to 7 per cent albumen). Duration, 2 to 28 days. All recovered. No relation between the severity of after effects and the nephritis.

In my series, cocaine and tropa-cocaine have about the same percentage of headaches, 18 2-3 for the former, 17 2-3 for the latter, while stovaine, the worst offender of all, gave 72 8-11%, that is, 8 in 11. All writers report headaches. Deetz had 14% in 360 stovainizations; Tuffier, cocaine, 40%; Schwartz and Baisch, tropa-cocaine, 16 2-3%; Neugebauer, about 30%; Slajmer, 25%, slight, 2% severe. Hermes, stovaine, 8 days to 8 weeks. Hauber, 200 cases stovaine, 46%, lasting from 10 to 17 days. One patient had severe headaches a quarter of a year. Lexer got headache in 25% of his cases, lasting for days, and very severe. Novocaine also produced headaches in 30 to 60% of the cases.

In my last 54 tropa-cocainizations, there were 12 headaches, one 7 days, severe, one 3, one 2 and the rest 12 to 24 hours each. In none of these had spinal fluid been allowed to escape. There are many conjectures as to the cause of these headaches. Meningeal irritation was assigned as a cause. I failed to find any evidence of this in the spinal fluid of one patient with severe headache. It was difficult to find cells, even after half an hour centrifuging. In the light of late publications (Chaput, Offergeld, etc.), it is peculiar that the withdrawal of over 2 drams of fluid gave this patient only temporary relief. For the literature of the past year contains many reports of the almost instantaneous relief afforded by the withdrawal of spinal fluid in headache, delirium, convulsions and other untoward after-effects of medullary anesthesia. Chaput was the first to introduce this measure (*Centralbl. f. Chir.*, No. 26. 1906). Schwartz, who had only 17 slight headaches in his last 300 cases, thinks they are due to the irritation produced by the blood extravasated at the site of puncture, and not to the effect of the drug, because simple lumbar puncture is so often followed by headache, etc. But, in six of my cases with very blood-stained liquor, 4 had no headaches and 2 only slight ones (12 hours). Finally, we have the theory of increased pressure, which is most probably one of the true causes. This was demonstrated with the clearness of an experiment in the patient before mentioned, who received 4 spinal punctures. The one that showed increase of intracranial pressure was followed by headache. Offergeld (*Centralbl. f. Gyn.*, vol. 31. No. 10) referred in the *Journal, A. M. A.*, May 11, 1907, demonstrated the increased pressure on rabbits, and applied the knowledge gained to guard against headaches in the human being by withdrawing 1 to 2 cc. of fluid before injecting the anesthetic. My cases, in which the fluid was withdrawn for the purpose of overcoming pressure and allowing higher anesthesia, were none of them followed by headaches (number of cases, however, too few). In the Bier clinic they also allow the fluid now to run off ad lib.

Another important after-effect of spinal anesthesia with tropa-cocaine is retention of urine. This occurred 10 times in my last 53 administrations. The longest was 4 weeks, following an operation for ischio-rectal abscess. Next 7 days 2 cases, piles.

Then one of 5 days, also after piles. The remainder were 2 cases of hemorrhoids 2 days each, internal urethrotomy 2 days, hernia 2 days, varicotomy 12 hours. Of 10 hernias, only one had retention. Six of the 10 cases of retention followed operations on the rectum—all the protracted ones did. This often occurs after general anesthesia, but never to the extent of 4 weeks. This case was as follows:

Frank A., aged 63; ischio rectal abscess, June 19, 1906. Operation, incision with division of the sphincter. Tropa coc., gr. 1, between the second and third spines. Small syringe, spinal fluid clear, normal tension, anesthesia up to the ensiform cartilage. Course, ideal. Post op., no pain or headache, but obstinate retention for 3 weeks. Then voluntary urination on one occasion, then further retention for another week, after which his condition became normal. Patient was in bed part of the time and up part of the time. He had been normal before the operation and showed no signs of spinal-cord disease, nor was there any history of syphilis.

In the other cases of retention, there is nothing of particular note. The prolonged retention following spinal analgesia is undoubtedly due to the action of the drug directly on the spinal cord, and has been known ever since the cocaine era—in fact, the method of treating incontinence of urine by epidural injection is based on this observation. (Cathelin.)

As regards cocaine and stovaine, I cannot give accurate details. I can only state that neither gave as long retention as tropa-cocaine, there being one case of 3 days' duration in 11 stovainizations—extirpation of inguinal glands.

**Pain**—A few patients complained of pain in the back, in one necessitating an injection of morphine. Pain in the wound occurred more frequently, and sometimes reached great intensity. This occurred particularly after bone and haemorrhoid operations, and strange to say, not after hernias. The pain sets in as soon as the anesthesia has entirely disappeared, and in one case lasted two and one-half days (wiring of femur).

**Vomiting**—Four patients out of 54 vomited slightly on returning to bed, one of whom, a boy of 14, had vomited before the puncture was given. Compare this record with ether.

A few patients complained of slight weakness of the back and legs on getting up, but this symptom rapidly passed away, with one exception, as follows:

Samuel L., age 38 operated February 16, 1904, for fistula in ano. Tropa-cocaine, gr. 1, between the fourth and fifth spines. Anesthesia prompt and up to the ensiform cartilage. No untoward symptoms during or after operation, except a temperature of 101.2-10 the next day; but 10 days later on patient getting out of bed, found himself unable to walk or even stand. In bed he moved his legs readily enough. No ataxia, no disturbance of sensation. The only factor of note in his previous history was soft chancre. There were no signs of lues on the man. His condition slowly improved. By degrees he managed to stand, and then to walk, afterwards getting about on crutches. On leaving the hospital, two months after operation, he was not yet able to raise his legs in walking. On April 17, 1906, that is, 2 years 1 month later, he had entirely re-

covered, except for a weakness in the lower part of the spine whenever he strained. In all, it had been between 4 and 6 months before he had regained the use of his lower limbs. Examination now showed a normal nervous system.

Here, then, we have an example of paraparesis after tropa-cocaine. That is was due to the drug, there can scarcely be any doubt. A lumbar puncture per se could scarcely have caused it. That the outcome was not graver is due to the slightly toxic drug used. Had stovaine been used, it is my firm conviction that a permanent paralysis would have resulted. In a case of paraplegia reported by Koenig of Altona, stovaine 1 gr. and adrenalin were used. The operation was for suture of a fractured patella. The puncture was given between the 3rd and 4th lumbar spines. The fluid was not clear, but rose-colored. In 15 minutes the anesthesia extended to the epigastrium, and from that time on the body of the patient from the umbilicus down became as dead as though the cord had been completely severed. The patient had the usual sequelae of stovaine, headache, nausea, pain and fever. A puncture 1 week later showed the same rose-colored liquor, which on culture proved sterile. Post-mortem 2 months later showed adhesion between the cord and the dura from the 9th dorsal vertebrae down. The cord itself showed the changes of softening, so that on cross-section in its lower portion, it ran like pus. Koenig explains the paralysis as due to the toxic action of the stovaine on a damaged cord. He thinks the red color of the spinal fluid denoted some pathological change in the cord so as to render it specially susceptible to the poison. I have already injected very bloody spinal fluid without any bad results, but I never use adrenalin. (Koenig Munch. Med. Woch. 23. 1906.)

Before closing, I wish to report the case of a patient with paraplegia, who died in the University of California surgical ward at the City and County Hospital. He had been punctured elsewhere and operated on for varicose veins of the right leg in March, 1904. Unfortunately, no details have been obtainable, so that all we can state is that the patient, J. D., received a spinal anesthetic, which was followed by a permanent paraplegia, extending to the umbilicus. Unlike Koenig's, which gave a picture of complete destruction of the cord, this case gave a typical picture of a transverse myelitis of the dorsal cord—analgesia disturbance of thermal and tactile senses, incontinence of feces and urine, trophic ulcers, contractures, increased reflexes. Patient died April 20, 1905, 13 months after operation.\*

This case is one of many, I believe, and just as it was never reported, so there are undoubtedly many others including deaths, which never see the light of publication. There are not many like Bosse who had the courage to publish the "worst statistics that have yet appeared." In 55 cases of stovaine, alypin and novocaine anesthesia, he had 8 misses (6 complete) one of paraplegia of the lower

\* Further light has been thrown on this case: Tropa-cocaine was probably the drug used, and the patient gave signs of spinal cord disease before the puncture, viz.: did not walk into the hospital unaided, and in the ward had various nervous disturbances to which no attention was paid at the time (tabes?), so that we have here an example of the effect of a spinal injection upon a damaged spinal cord.



extremities and 2 deaths. He said, however, that his object was to bring into prominent view the shadowy side of spinal anesthesia. He succeeded!

I have had no deaths in my series, but in 6875 cocaine analgesias reported by various authors, there were 24 deaths—1 in 275; 7059 tropa-cocaine, 10 deaths—1 in 705.9; 5636 stovaine, 7 deaths—1 in 805; eucaïne, 817—1 death; novocaine, 947, 3 deaths—1 in 315.23. (Strauss, *Deut. Zeit. f. Chir.*, July, 1907.)

Among these are some that, strictly speaking, do not belong there, the deaths having occurred rather post hoc than propter hoc, so that Strauss, by careful selection, figures out a mortality of 1 in 2524. To illustrate how deceptive statistics are, the above table gives the relatively harmless tropa-cocaine a mortality of 1 in 705, while the far more dangerous stovaine gets off with 1 in 805. In the above reported cases, there are surely no concealments, the death rate is bad enough without. Compared with spinal analgesia, chloroform and ether are practically harmless; yet I do not think our case as bad as it may seem. The optimism and indiscriminate puncturing of the past is giving place to a saner attitude. The more poisonous drugs have been eliminated. Technic has been perfected, and operators have become more skillful, so that the future will show a decided improvement in the death rate and accidents after spinal analgesia. We must learn, moreover, to avoid such accidents as befell Koenig, and never inject where we suspect a diseased spinal cord. In such cases even the non-poisonous tropa-cocaine may have dire effects. If we can be sure of our ability to avoid such accidents in the future, spinal tropa-cocainization will have a fixed place amongst the accepted methods of anesthesia. That it will ever rival ether or chloroform is out of the question, but it will have its uses and in selected cases will be the method par excellence.

**Literature**—1. Strauss—Present Status of Sp. Anesth. *Deutsche Zeitschrift für Chirurgie*, July, 1907, Vol. 89, Nos. 1-4, p. 133. This work gives the complete literature of sp. analgesia up to the time of publication.

2. Bosse—"Die Lumbalanästhesie," by Dr. Buno Bosse, 1907, gives the best resume of the literature up to the present time. The following have appeared since:

Ach—Sp. Anesthesia. *Munich Med. Woch.*, Aug. 13, 1907, No. 33.

Hesse—Complications after Sp. Analg. (tropacoc.), *Deut. Med. Woch.*, 37, Sept. 12, 1907. (Ref. J. A. M. A.) Oct. 19, 1907.

3. Kronig—Gauss-Munch. *Med. Woch.*, July 1, 1907. One thousand cases of Sp. Anesth. (Stovaine-adren.) with Scop-Morph.

4. Oelsuer (Sonnenburg's Clinic) 875 cases Sp. Analgesia (Stovaine, novocaine, adrenalin, stovaine, adrenalin), *Deut. Zeitschaf. chir.* v. 90, Oct., 1907.

5. J. Oehler (Kummel's Clinic), 1000 cases of Sp. Analgesia (eucaïne, stovaine, novocaine, alypin, finally tropa-cocaine with adrenalin). *Beitragez. Klin-Chir.*, vol. lv., p. 425, Nov., 1907.

6. Uselessness of adrenalin in Sp. Anesthesia. Nickelssohn. *Munich Med. Woch.*, Dec. 10, 1907, No. 50.

## A PLEA FOR U. S. ARMY CONTRACT SURGEONS.

By H. du R. PHELAN, M. D., San Francisco.

The untimely death of Major Carroll of the Medical Department of the Army, brings out the fact that it was as a contract surgeon that he earned at the cost of his health and of his life the title of "Benefactor of Humanity," by the discovery of the agent of transmission of yellow fever.

As it will be remembered, in the year 1900, a commission was appointed to meet at Havana for the purpose of investigating the etiology of yellow fever then prevalent among our troops. This commission was composed of Dr. Walter Reed, Dr. James Carroll, Dr. Jesse W. Lazear and Dr. Aristides Agramonte. Carroll, Lazear and Agramonte were all three contract surgeons—that is, civilian physicians serving under contract with the Army. Dr. Reed alone held a commission in the regular establishment.

If I remember right, it was agreed among the several members of the commission that each in turn would expose himself to the bite of an infected mosquito in order to prove the theory of transmission of the disease by that insect. Contract Surgeon Carroll was the first to contract the disease experimentally, and this was all the more heroic that he had a wife and five young children depending on him for support. Contract Surgeon Lazear allowed himself in turn to be bitten, and soon after he gave up his life in behalf of science, leaving a widow and two children, the younger of whom he had never seen. Major Surgeon Reed was absent in the United States at the time his colleagues were exposing themselves to infection, and was never bitten experimentally by a yellow fever mosquito. Contract Surgeon Agramonte, as an immune, was a lesser hero but a no lesser scientific and painstaking member of the commission which fixed upon the mosquito *stegomyia fasciata* the odium of spreading yellow fever and death throughout the world.

The achievements of these contract surgeons should have been sufficient to attract attention to the anomalous position of a body of surgeons, the like of which exists in the army of no other nation; and yet it did not. Several contract surgeons, it is true, were taken into the regular establishment or otherwise honored, but the corps as a whole received a blow or two which deeply wounded the amour propre of its members.

For a short time contract surgeons were called Acting Assistant Surgeons, and wore the uniform and insignia of first lieutenants, the latter being of silver instead of gold. While officially they were civilians, yet they had the outward appearance of officers, and were therefore better able to maintain discipline and to otherwise perform the duties of their office. In 1901, immediately after the great discovery of Reed, Carroll, Lazear and Agramonte had startled the world, the corps of contract surgeons which already counted among its members several heroes or martyrs to science and to duty, received its first blow. The title of Acting Assistant Surgeon was denied it, and that of Contract Surgeon, which subsists till this day, was substituted